Radioactivity in the Risø District January-June 2011

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Risø-R-Report

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Risø-R-1800(EN)
December 2011

Risø DTU
National Laboratory for Sustainable Energy

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Title: Radioactivity in the Risø District January-June 2011
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Abstract (max. 2000 char.): The environmental surveillance of the Risø environment was continued in January-June 2011. The mean concentrations in air were: 7.97±20.7 μBq m^{-3} of ^{137}Cs, 2.82±1.18 mBq m^{-3} of ^{7}Be and 0.16±0.14 mBq m^{-3} of ^{210}Pb (±1 S.D.; N = 26). The unusually high mean value and standard deviation over the period for ^{137}Cs were due to highly enhanced concentrations in a period in March-May caused by the releases from the Fukushima accident in Japan. This is also reflected in the values for ^{134}Cs and ^{131}I. The depositions by precipitation at Risø in the first half of 2011 were: 0.527 Bq m^{-2} of ^{137}Cs (correspondingly unusually high), 481 Bq m^{-2} of ^{7}Be, 40.4 Bq m^{-2} of ^{210}Pb and < 1.3 kBq m^{-2} of ^{3}H. The average background dose rate (TLD) at Risø (Zone I) was 64 nSv h^{-1} compared with 50 ± 11 nSv h^{-1} (±1 S.D.; N = 4) in the four zones around Risø.

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Table 1. Radionuclides in ground level air collected at Risø (cf. Figs. 1, 1.1 and 1.2), January - June 2011. (Unit: μBq m^{-3})

Date		^{7}Be	^{137}Cs	^{134}Cs	^{131}I	^{210}Pb
27-Dec-10 –	03-Jan-11	1229	0.610	< 0.42	< 0.88	145
03-Jan-11 –	10-Jan-11	2296	0.445	< 0.36	< 0.88	93
10-Jan-11 –	17-Jan-11	1834	0.216	< 0.42	< 0.97	54
17-Jan-11 –	24-Jan-11	1173	0.354	< 0.35	< 0.77	36
24-Jan-11 –	31-Jan-11	1778	0.619	< 0.31	< 0.78	44
31-Jan-11 –	07-Feb-11	3062	0.204	< 0.45	< 1.20	47
07-Feb-11 –	14-Feb-11	1935	0.211	< 0.26	< 0.68	61
14-Feb-11 –	21-Feb-11	3665	1.132	< 0.61	< 1.57	654
21-Feb-11 –	28-Feb-11	2585	1.265	< 0.24	< 0.68	442
28-Feb-11 –	07-Mar-11	1735	0.704	< 0.42	< 1.01	217
07-Mar-11 –	14-Mar-11	1516	0.219	< 0.43	< 1.05	67
14-Mar-11 –	21-Mar-11	2167	0.515	< 0.89	< 1.75	141
21-Mar-11 –	28-Mar-11	2879	5.516	33.3	379	75
28-Mar-11 –	04-Apr-11	1925	100.218	76.5	484	66
04-Apr-11 –	11-Apr-11	1482	35.182	35.7	183	47
11-Apr-11 –	18-Apr-11	2750	28.548	28.4	84.2	172
18-Apr-11 –	26-Apr-11	4528	11.755	13.0	20.9	249
26-Apr-11 –	02-May-11	4027	11.733	13.0	14.8	253
02-May-11 –	09-May-11	3584	4.775	5.87	4.7	227
09-May-11 –	16-May-11	2556	0.841	< 0.72	< 1.7	205
16-May-11 –	23-May-11	2757	0.525	< 0.84	< 1.9	130
23-May-11 –	30-May-11	5275	0.599	< 0.88	< 2.3	127
30-May-11 –	06-Jun-11	3272	0.333	< 0.95	< 2.3	156
06-Jun-11 –	14-Jun-11	4435	0.294	< 0.74	< 2.0	233
14-Jun-11 –	20-Jun-11	4426	0.196	< 0.43	< 1.1	136
20-Jun-11 –	27-Jun-11	4597	0.214	< 0.73	< 1.7	142
Mean		2826	7.97			162
SD		1178	20.8			136

Table 2.1. Radionuclides in precipitation in the 10 m^2 rain collector at Risø (cf. Fig. 1), January - June 2011. (Unit: Bq m^{-3})

Month	^{7}Be	^{137}Cs	^{210}Pb
January	1155	0.149	164
February	602	-	6
March	1749	5.852	208
April	1456	6.967	131
May	4614	3.790	412
June	2507	0.381	91

Table 2.2. Radionuclides in precipitation in the 10 m^2 rain collector at Risø (cf. Fig. 1), January - June 2011. (Unit: Bq m^{-2})

Month	Precipitation (m)	^{7}Be	^{137}Cs	^{210}Pb
January	0.048	55.8	0.0072	7.9
February	0.028	16.7	-	0.2
March	0.031	55.1	0.1843	6.6
April	0.022	31.3	0.1498	2.8
May	0.045	210.0	0.1722	18.8
June	0.045	112.0	0.0136	4.1
Sum	0.219	480.9	0.5271	40.4

Table 2.3. Tritium in precipitation collected at Risø (cf. Figs. 1, 2.3.1 and 2.3.2). January - June 2011. (Unit: kBq m^{-3})

Month	1 m^2 rain collector*	10 m^2 rain collector*
January	< 1.7	< 2.3
February	< 1.7	< 1.7
March	2.7	3.1
April	3.0	20.0
May	< 1.9	5.5
June	3.2	6.5

Double determinations*.

Table 2.4. Tritium in precipitation collected at Risø (cf. Fig. 1). January - June 2011. (Unit: kBq m^{-2})

Month	Precipitation (m)	1 m^2 rain collector	10 m^2 rain collector
January	0.048	< 0.082	< 0.110
February	0.028	< 0.048	< 0.048
March	0.031	0.084	0.096
April	0.022	0.066	0.440
May	0.045	< 0.086	0.248
June	0.045	0.144	0.293
Sum	0.219	< 0.508	< 1.234

Table 3.1. Radionuclides in sediment samples collected at Bolund in Roskilde Fjord.(cf. Fig. 3.1) January - June 2011. (Unit: Bq kg^{-1} dry)

No samples in this period.

Table 4.1. Radionuclides in seawater collected in Roskilde Fjord (cf. Fig. 4.1) January - June 2011. (Unit: Bq m^{-3})

No samples in this period.

Table 4.2. Tritium in seawater collected in Roskilde Fjord (Risø pier) (cf. Fig. 4.2) January - June 2011.

Month	kBq m^{-3}
January	< 1.7 *
February	2.7 *
March	1.9 *
April	< 1.7 *
May	< 1.7 *
June	2.7 *

* Double determinations

Table 5.1. Radionuclides in grass (snow) collected at Risø (near the Waste Treatment Station (cf. Fig. 1)), January - June 2011. (**Measured on bulked ash samples)*

Week no. or month	Date	K (g kg^{-1} fresh)	^{137}Cs (Bq kg^{-1} fresh)	^{137}Cs (Bq m^{-2})
1	3 January*	<0.1	<0.2	
2	10 January*	<0.1	<0.2	
3	17 January	3.3	<0.4	
4	24 January	2.5	<0.4	
5	31 January*	<0.1	<0.3	
6	7 February	1.8	<0.4	
7	14 February	1.6	<0.9	
8	21 February	2.1	<0.9	
9	28 February	2.0	<1.0	
10	7 March	2.5	<0.4	
11	14 March	1.0	<0.4	
12	21 March	1.8	<1.0	
13	28 March	2.2	<0.2	
14	4 April	3.7	<1.0	
15	11 April	5.1	<1.0	
16	18 April	5.5	<0.7	
17	26 April	5.9	<0.9	
18	2 May	4.4	<0.6	
19	9 May	5.2	<0.5	
20	16 May	4.9	<0.5	
21	23 May	4.3	<0.4	
22	30 May	4.5	<0.4	
23	6 June	5.8	<0.4	
[+]25	20 June	4.8	<0.5	
**January		2.8	0.070	0.037
**February		1.7	0.139	0.043
**March		2.5	0.312	0.076
**April		5.1	0.855	0.166
**May		5.0	0.187	0.097
**June		5.3	0.068	0.059

[+] Note: After week 23 of 2011, the sampling frequency is fortnightly.

Table 5.2. Radionuclides in Fucus vesiculosus collected at Bolund in Roskilde Fjord. January - June 2011. (Unit: Bq kg^{-1} dry)

No samples in this period.

Table 7.1. Waste water collected at Risø (cf. Fig. 1), January - June 2011.

Week number	eqv. mg KCl l^{-1}	^{137}Cs (Bq m^{-3})	^{131}I (Bq m^{-3})	^{226}Ra (Bq m^{-3})
1	48	<128	<135	<278
2	44	<115	<117	<234
3	22	<118	<116	<214
4	45	<121	<114	<221
5	37	<71	<73	<140
6	36	<105	<111	<209
7	45	<106	<106	<228
8	39	<105	<109	<206
9	57	<107	<112	<215
10	67	<109	<110	<214
11	74	<105	<108	<210
12	83	<112	<115	<217
13	85	<118	<121	<229
14	57	<109	<115	<230
15	67	<111	<116	<209
16	78	<74	<62	347
17	60	<116	<119	<227
18	82	<113	<119	<223
19	88	<92	<101	<187
20	85	<120	<117	<215
21	86	<111	<111	<213
22	78	<115	<118	<220
23	79	<112	<114	<225
24	88	<104	<106	<198
25	95	<65	<77	<131
26	97	<69	<67	312
Mean	66.2			
SD	21.2			

Table 8.1. Background dose rates around the border of Risø (cf. Fig. 8.1) measured with thermoluminescence dosimeters (TLD) in the period November 2010 – April 2011. (Results are normalized to nSv h^{-1})

Location	nSv h^{-1}
1	55
2	43
3	39
4	46
5	51
6	63
Mean	50

Table 8.2. Background dose rates around Risø (cf. Fig. 8.2 and Fig. 1) measured with thermoluminescence dosimeters (TLD) in the period November 2010 – April 2011. (Results are normalized to nSv h^{-1})

Risø zone	Location	nSv h^{-1}
I	1	42
I	2	53
I	3	107
I	4	57
I	5	61
Mean		64
II	P1	53
II	P2	53
II	P3	34
II	P4	59
Mean		50
III	P1	45
III	P2	51
III	P3	42
Mean		46
IV	P1	41
IV	P2	41
IV	P3	48
IV	P4	57
IV	P5	50
IV	P6	46
IV	P7	61
Mean		49
V	P1	53
V	P2	49
V	P3	64
V	P4	39
V	P5	57
V	P6	36
V	P7	45
V	P8	62
V	P9	46
V	P10	55
Mean		51

Table 8.3. Terrestrial dose rates at the Risø zones (cf. Fig. 8.2 and Fig. 1) January - June 2011. Measured with a NaI(Tl) detector. (Unit: nSv h^{-1})

Risø zone	Location	January	April
I	P1	38	34
I	P2	45	41
I	P3	344	311
I	P4	40	38
I	P5	45	48
Mean		102	94
II	P1	35	45
II	P2	34	39
II	P3	33	34
II	P4	34	35
Mean		34	38
III	P1		46
III	P2		47
III	P3		41
Mean			45
IV	P1		35
IV	P2		46
IV	P3		42
IV	P4		38
IV	P5		36
IV	P6		37
IV	P7		40
Mean			39
V	P1		33
V	P2		43
V	P3		49
V	P4		44
V	P5		43
V	P6		41
V	P7		34
V	P7a		36
V	P8		45
V	P9		44
V	P10		34
Mean			41

Fig. 1. Locations for measurements of gamma-background radiation Zone I and II (cf. Tables 8.2 and 8.3)

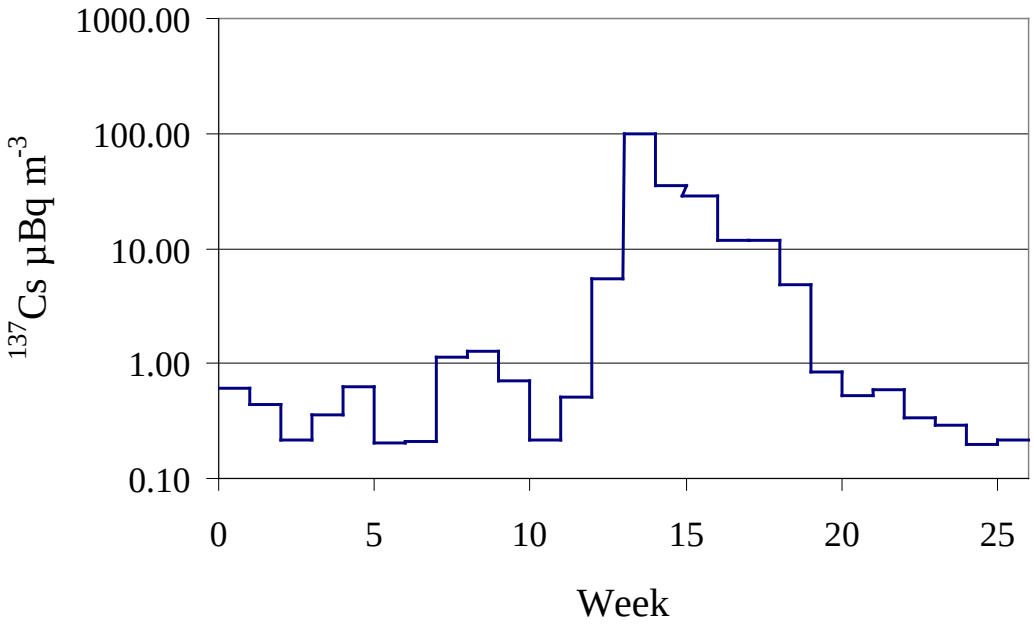

Fig. 1.1. Caesium-137 in ground level air collected at Risø in January-June 2011. (Unit: µBq m^{-3})

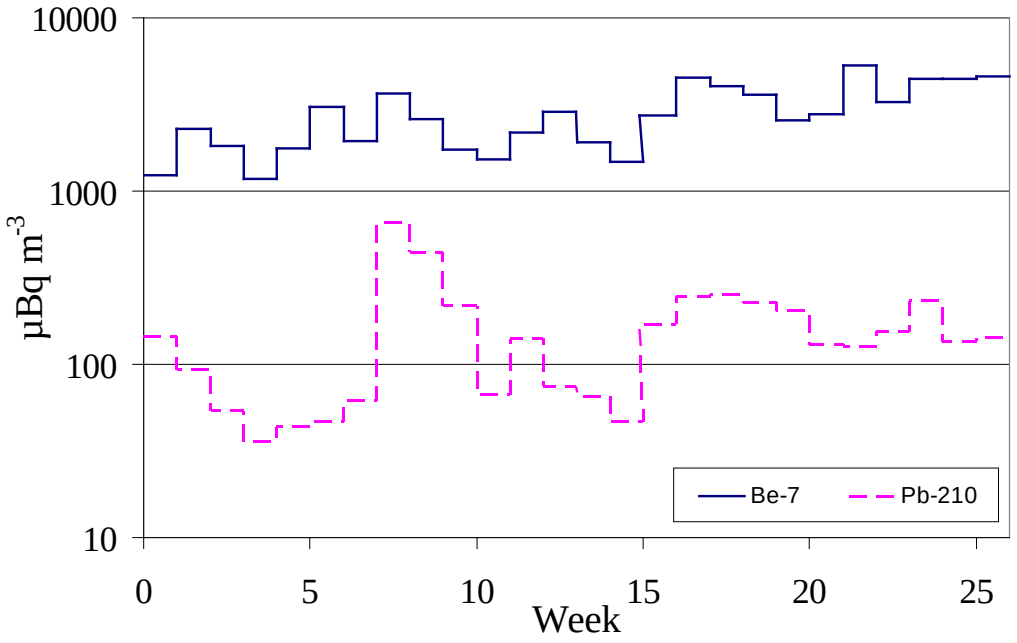

Fig. 1.2. Beryllium-7 and Lead-210 in ground level air collected at Risø in January-June 2011. (Unit: µBq m^{-3})

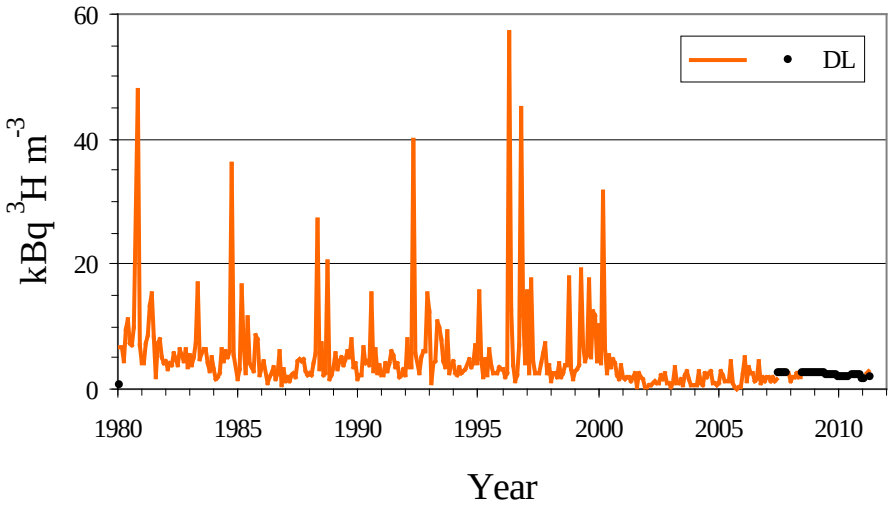

Fig. 2.3.1. Tritium in precipitation collected at Risø (1 m^2 rain collector) 1980 - 2011. (Unit: kBq m^{-3}; DL = detection limit)

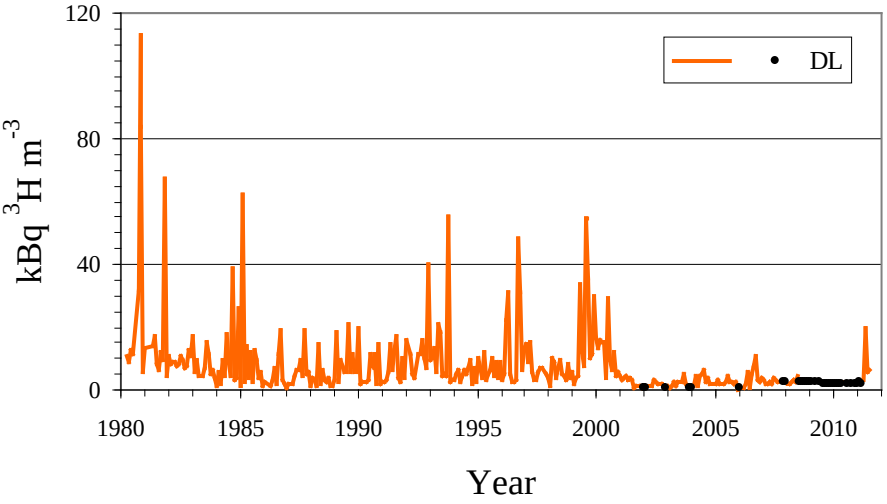

Fig. 2.3.2. Tritium in precipitation collected at Risø (10 m^2 rain collector) 1980 - 2011. (Unit: kBq m^{-3}; DL = detection limit)

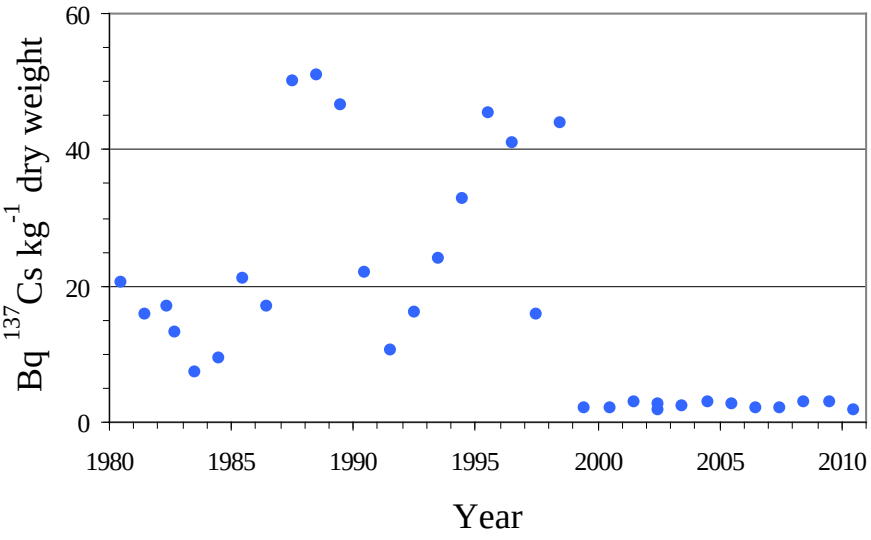

Fig. 3.1. Caesium–137 in sediment samples collected at Bolund in Roskilde Fjord. 1980 – 2011. (Unit: Bq kg^{-1} dry matter)

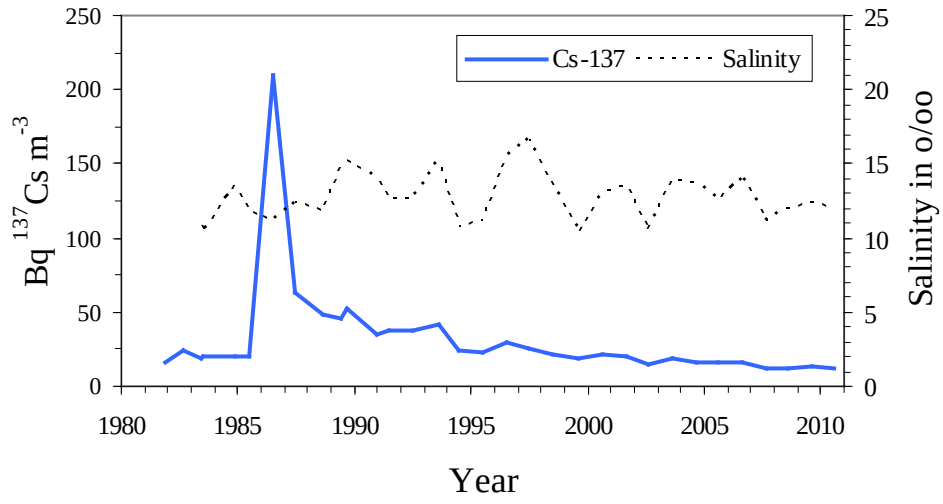

Fig. 4.1. Caesium–137 in seawater collected in Roskilde Fjord 1980 - 2011. (Unit: Bq m^{-3})

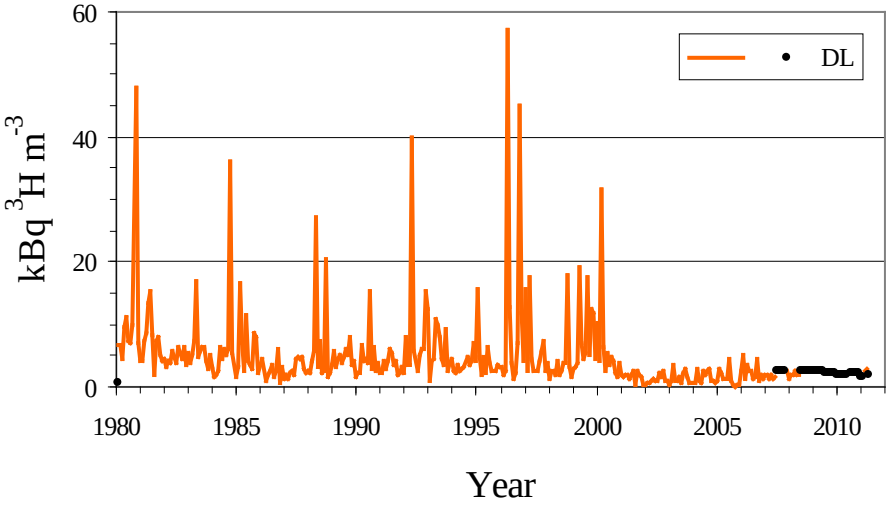

Fig. 4.2. Tritium in seawater collected in Roskilde Fjord 1980 - 2011. (Unit: kBq m^{-3}; DL = detection limit)

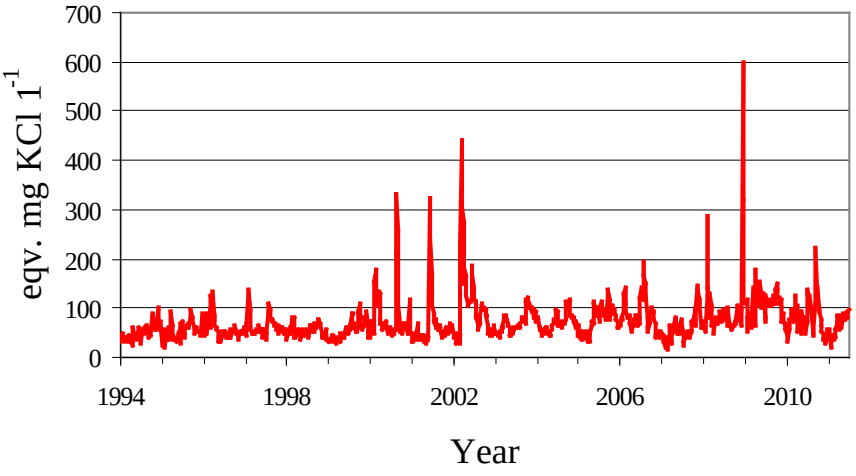

Fig. 7.1. Total-beta radioactivity in waste water collected at Risø 1994 - 2011. (Unit: eqv. mg KCl l^{-1})

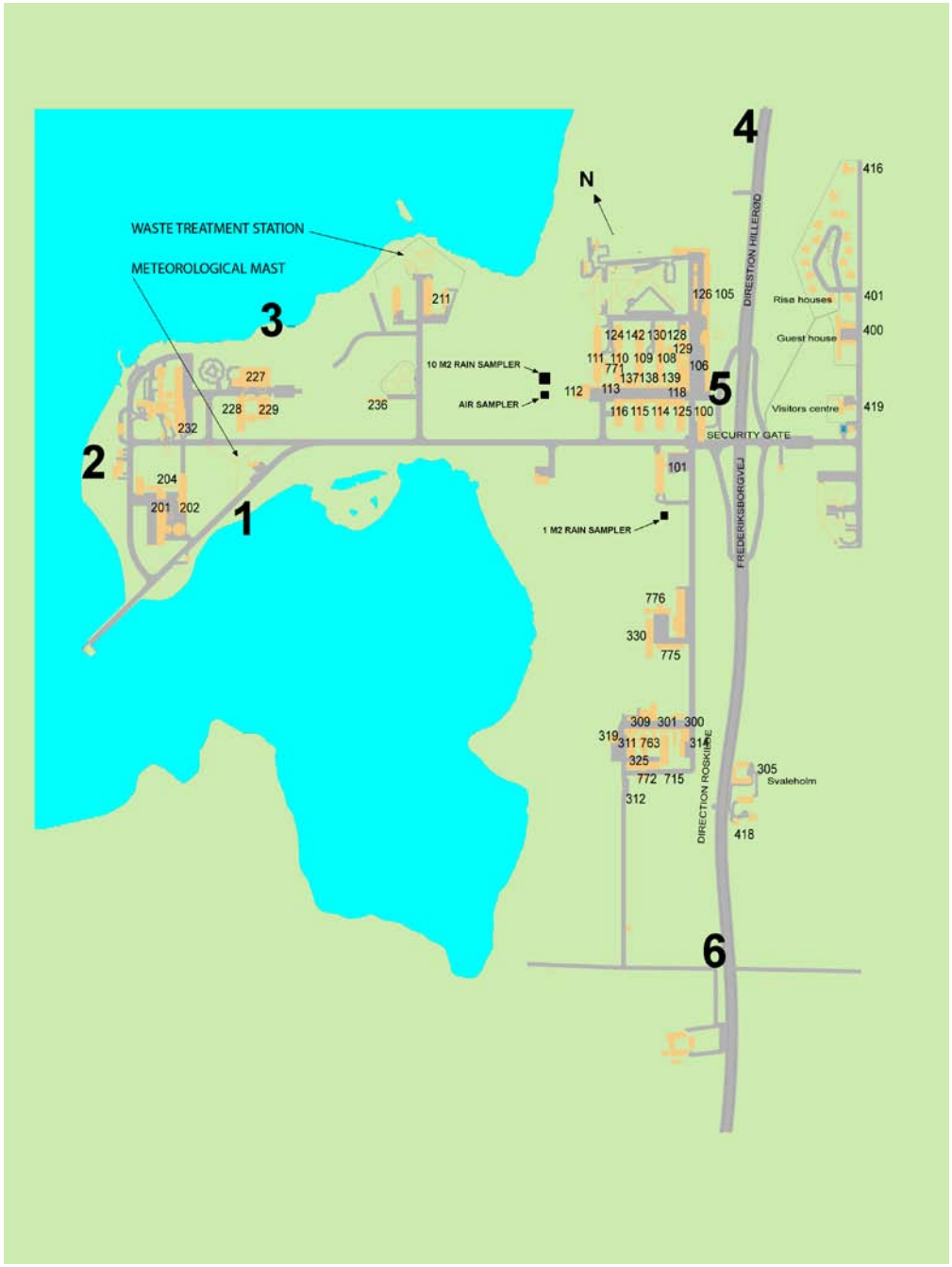

Fig. 8.1. Locations (1-6) for TLD measurements around the border of Risø (cf. Table 8.1).

Fig. 8.2. Locations for measurements of background radiation around Risø in Zones III, IV and V.

Risø DTU is the National Laboratory for Sustainable Energy. Our research focuses on development of energy technologies and systems with minimal effect on climate, and contributes to innovation, education and policy. Risø has large experimental facilities and interdisciplinary research environments, and includes the national centre for nuclear technologies.

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